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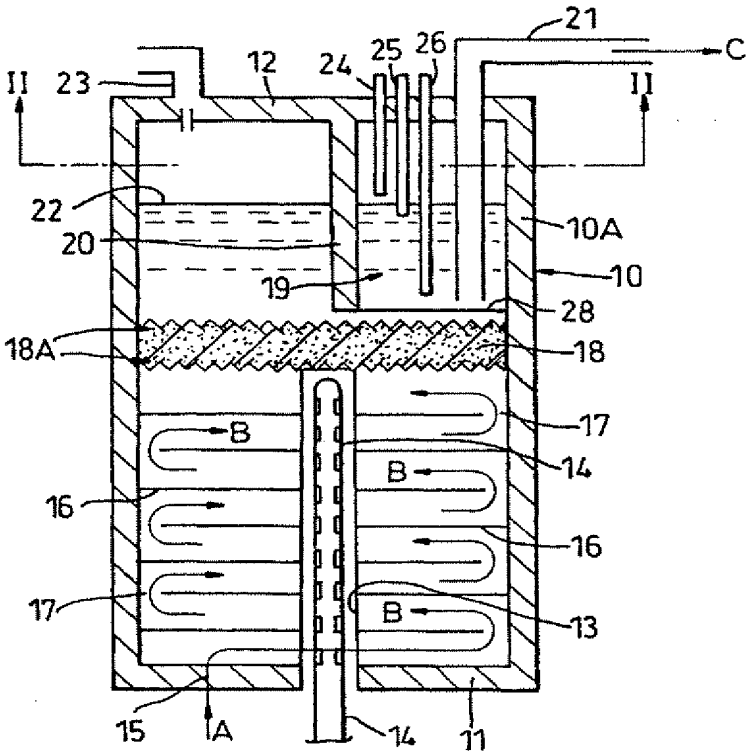
(54) Title: WATER TREATMENT DEVICE WITH LIQUID LEVEL CONTROL

(57) Abstract

The invention provides a water treatment apparatus to remove impurities, the apparatus comprising a housing (10, 70) having an inlet (15; 77, 80) for the water to be treated, an outlet (21, 85) for the treated water and treatment means (14, 16, 17, 18, 18A, 82) within the housing (10, 70) to remove impurities from the water, characterised in that one or more probes (24, 25, 26, 32, 34, 36) are provided within the housing to detect the level (22) of water in the housing, the probes (24, 25, 26, 32, 34, 36) being fitted within a separate chamber (19) in the housing, the chamber (19) receiving only treated water from the treatment means within the housing.



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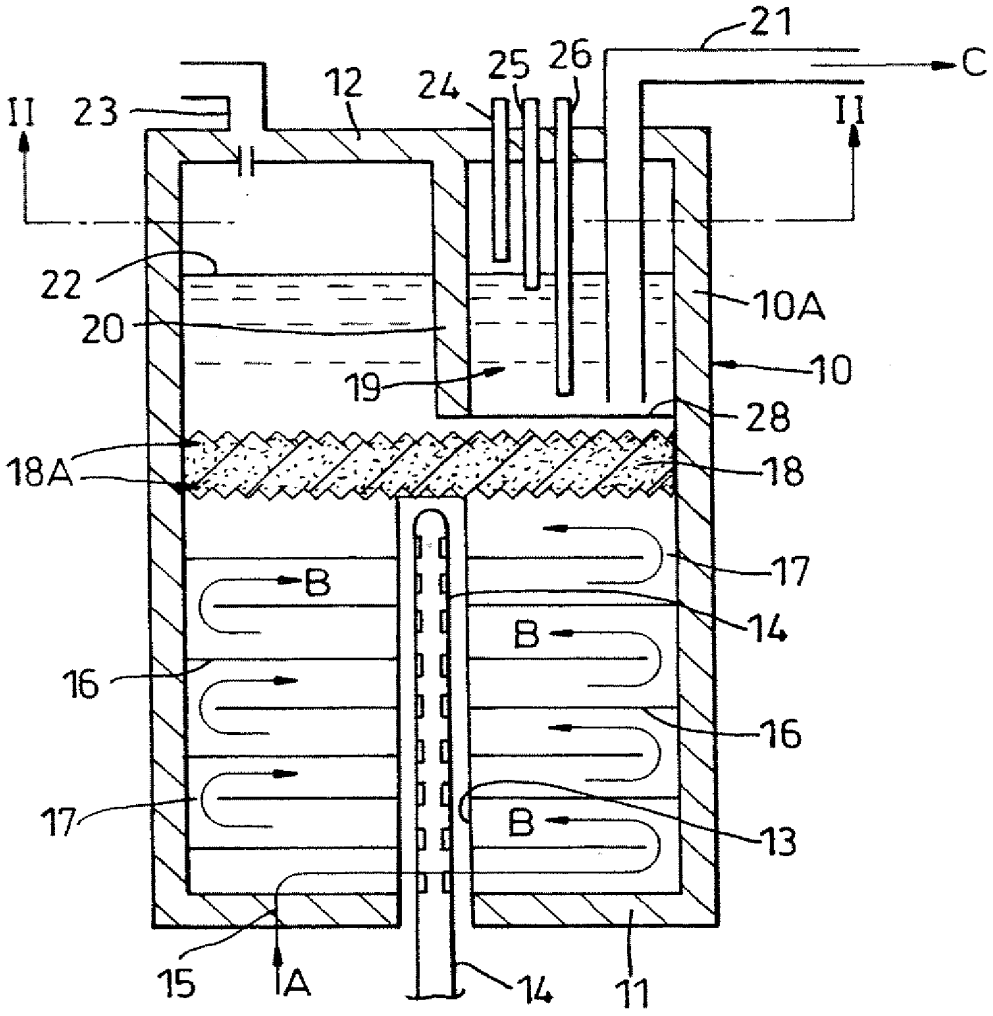
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Fig. 1

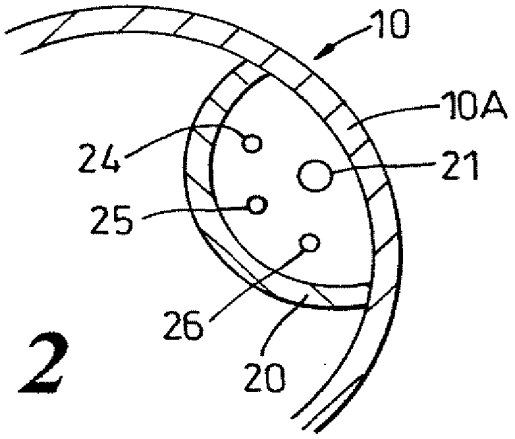
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Fig. 2

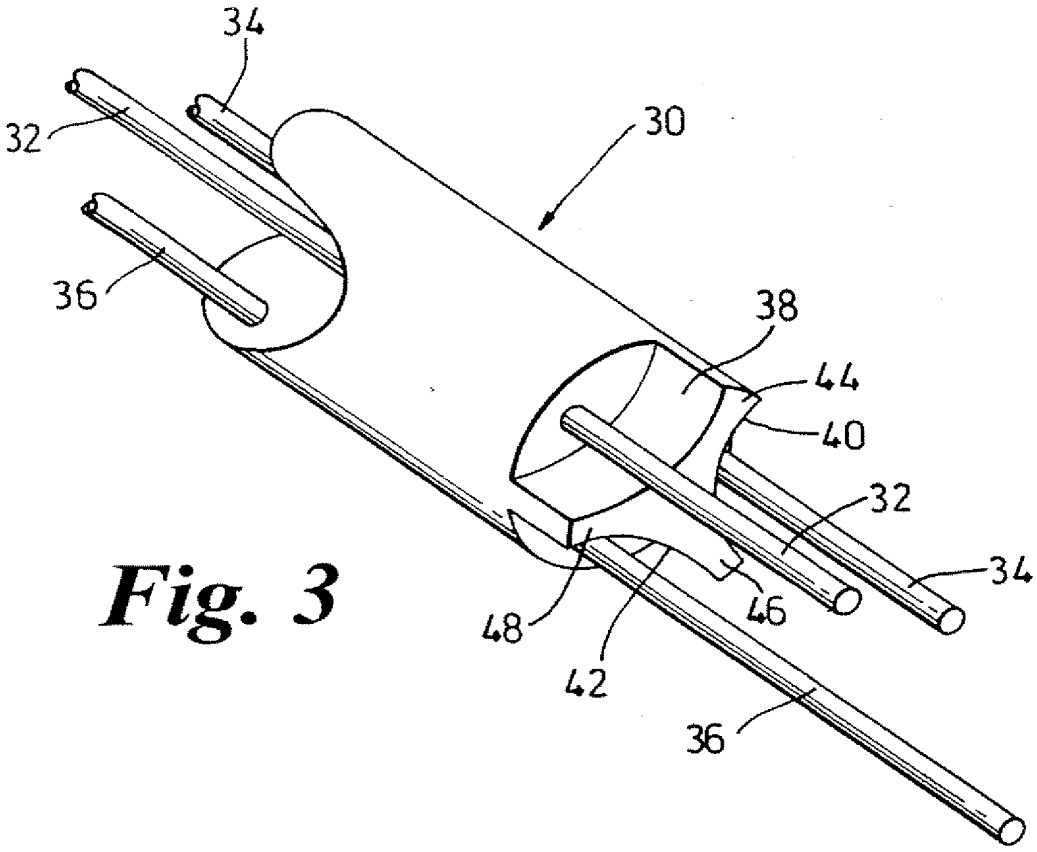

Fig. 3

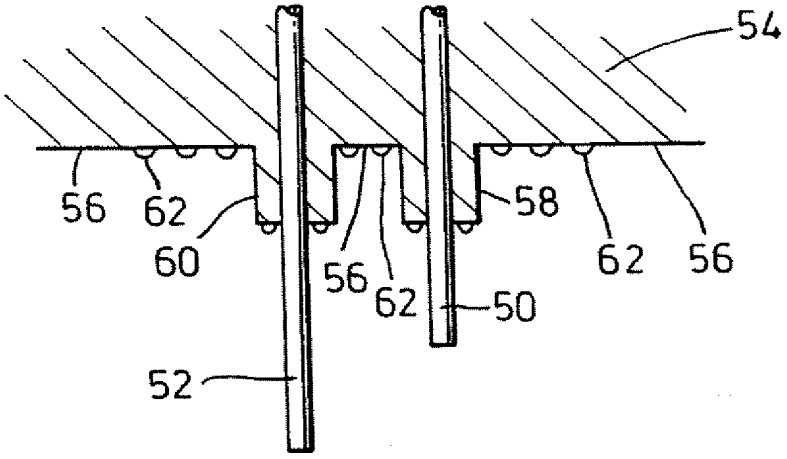

Fig. 4

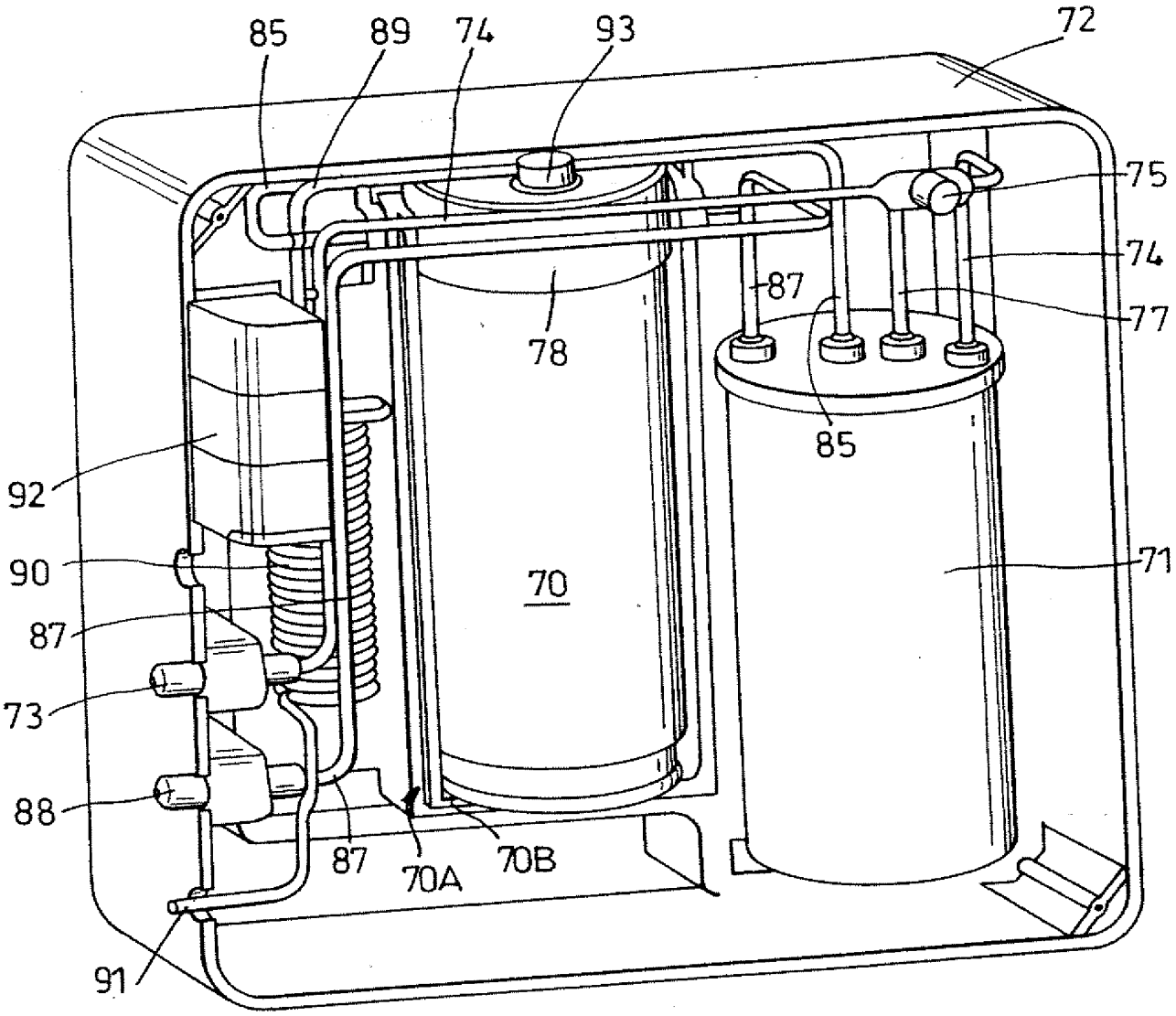

Fig. 5

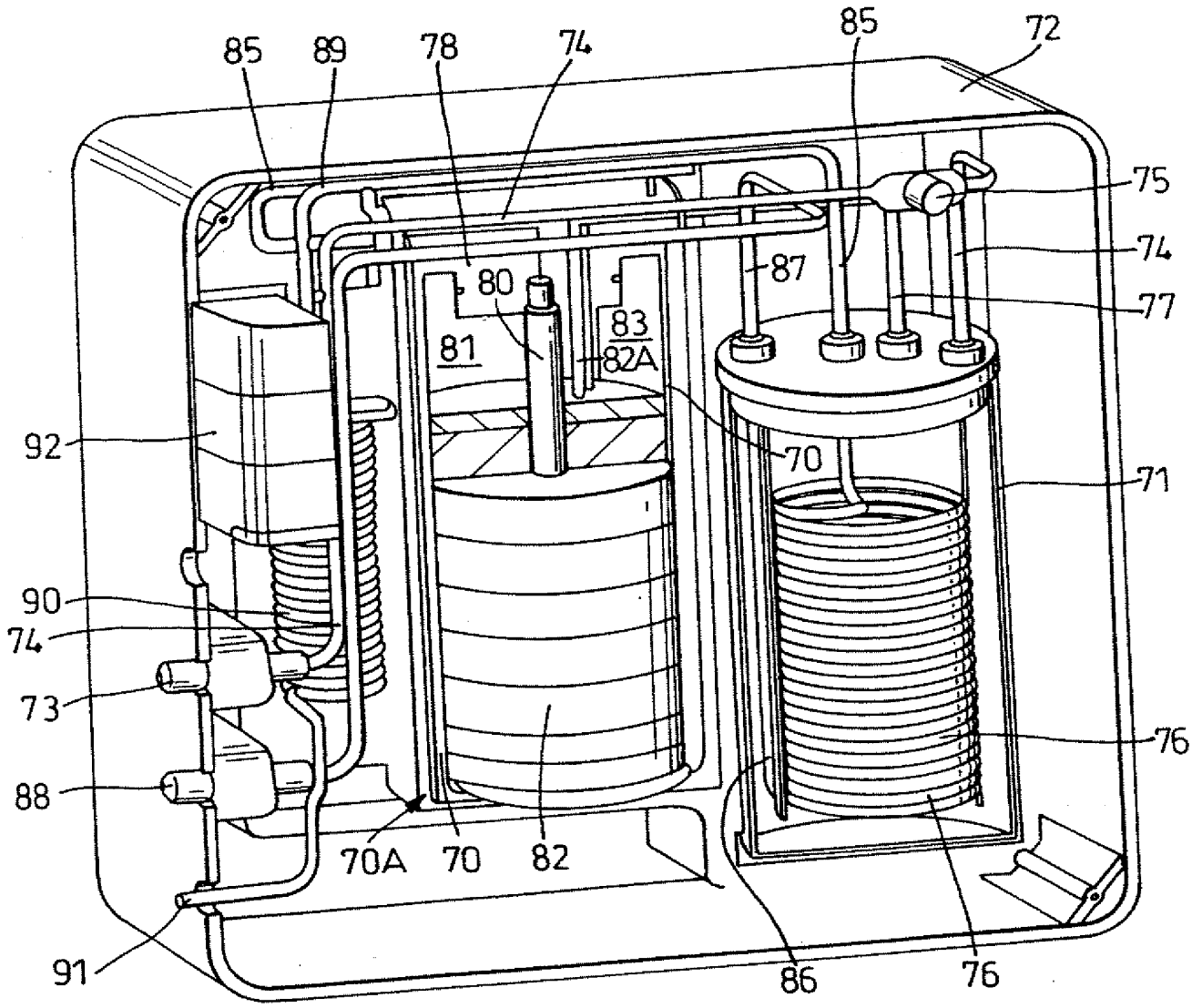
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Fig. 6

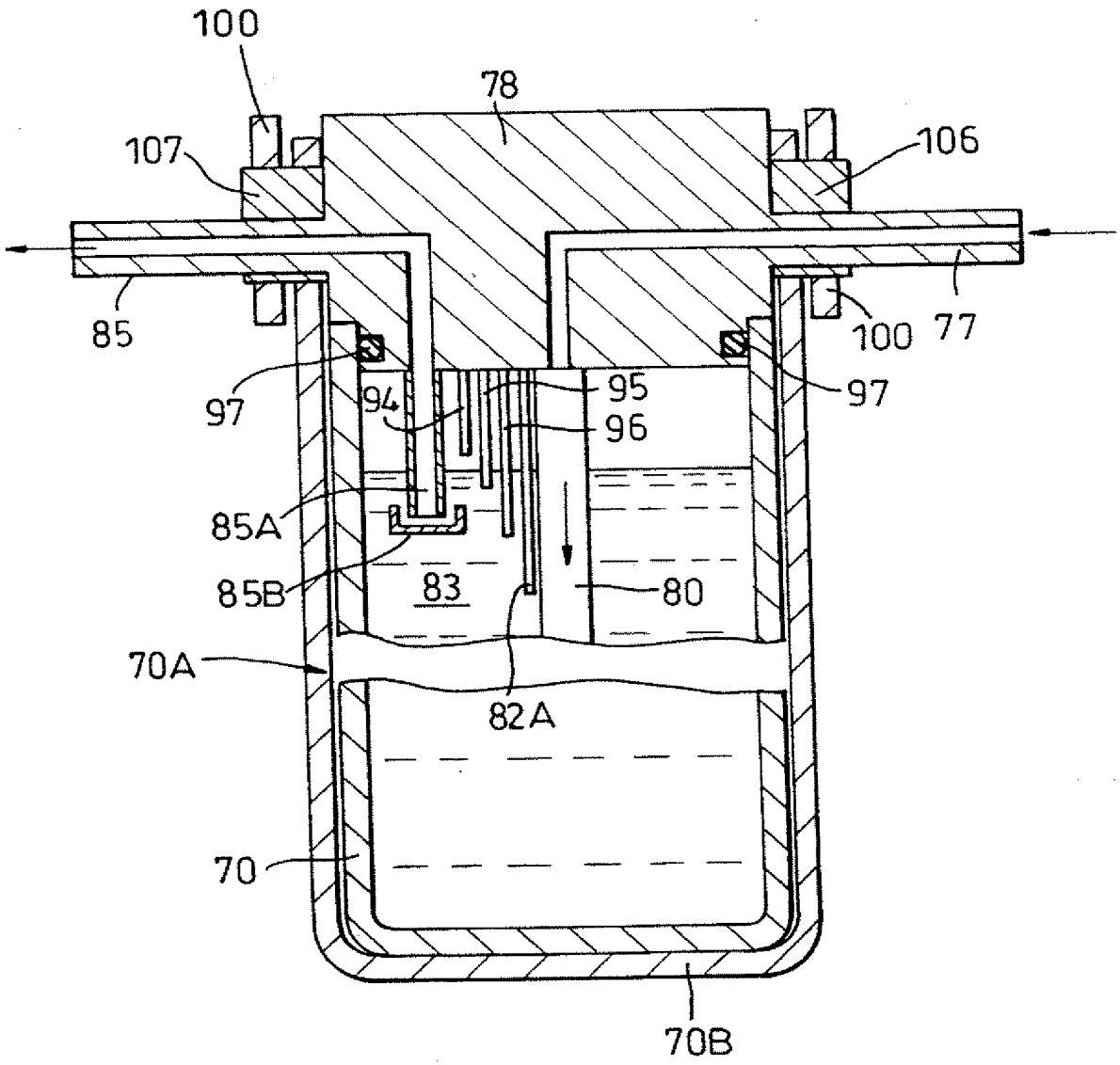

Fig. 7

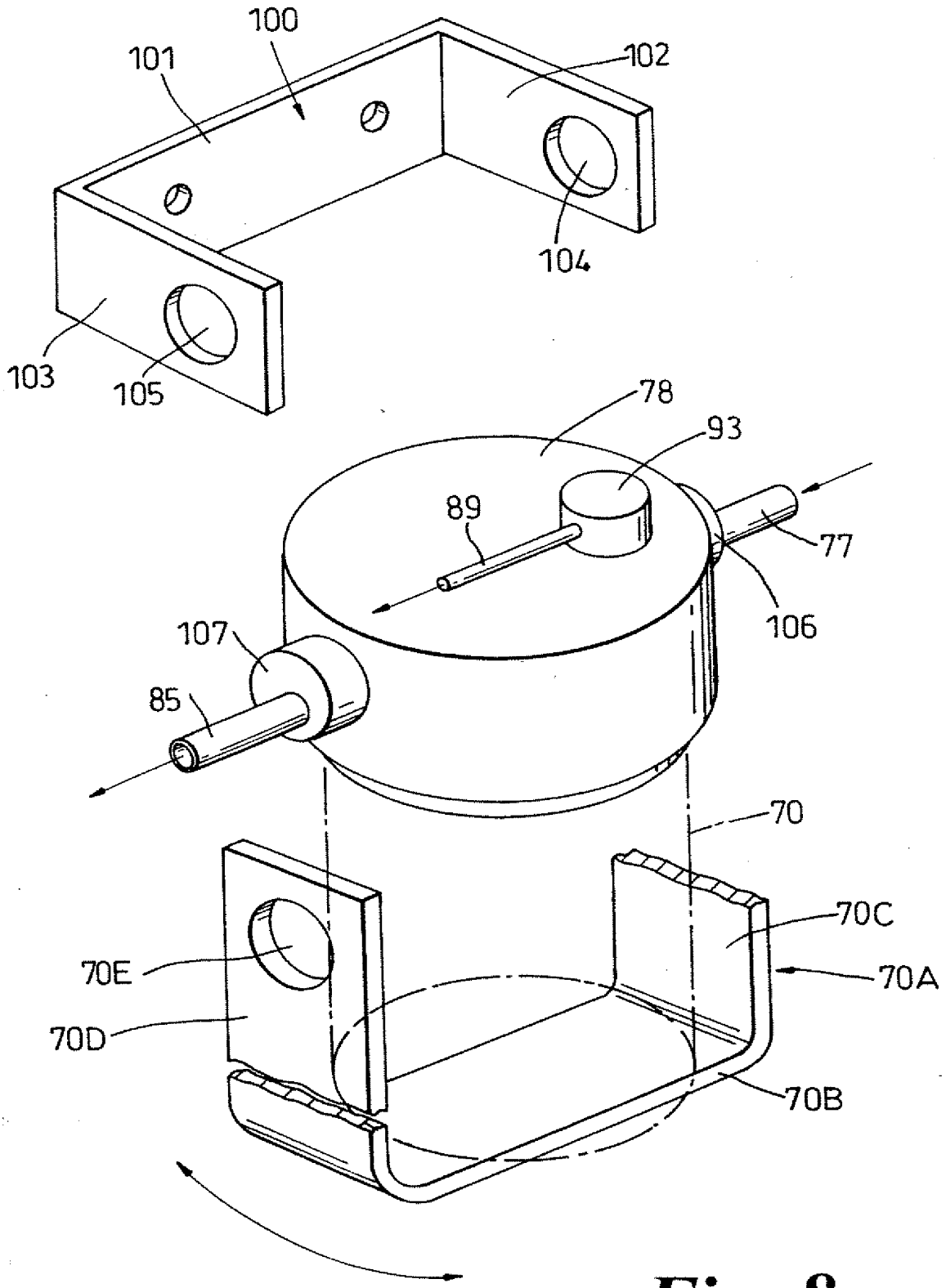
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Fig. 8

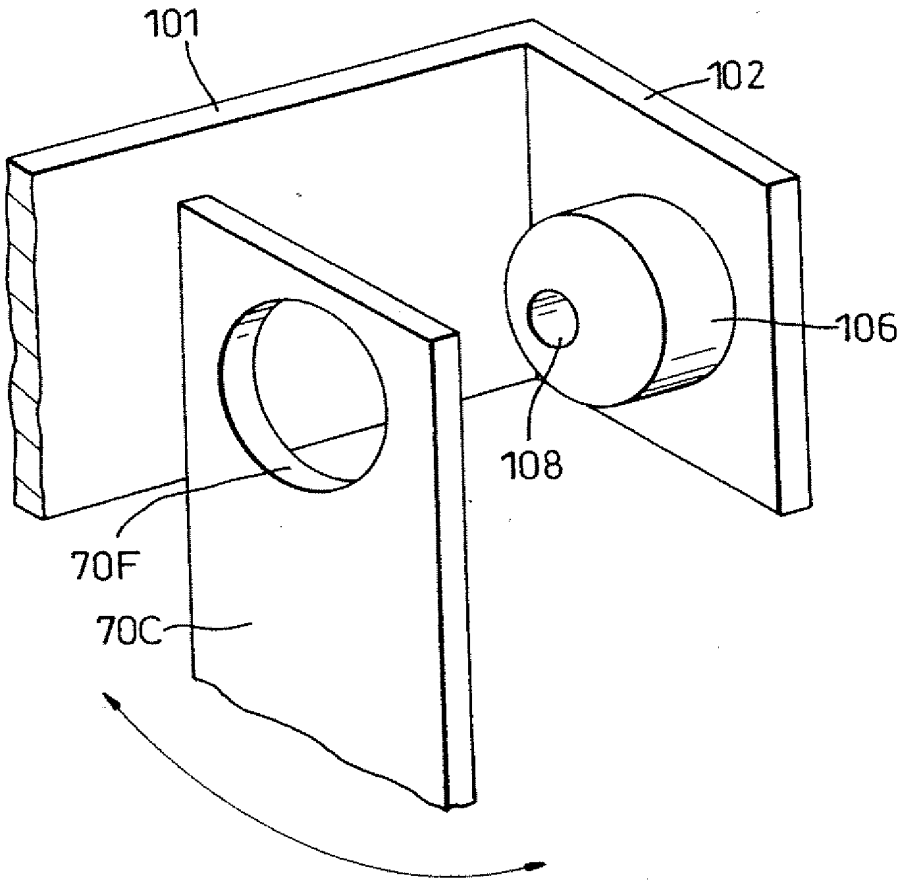

Fig. 9

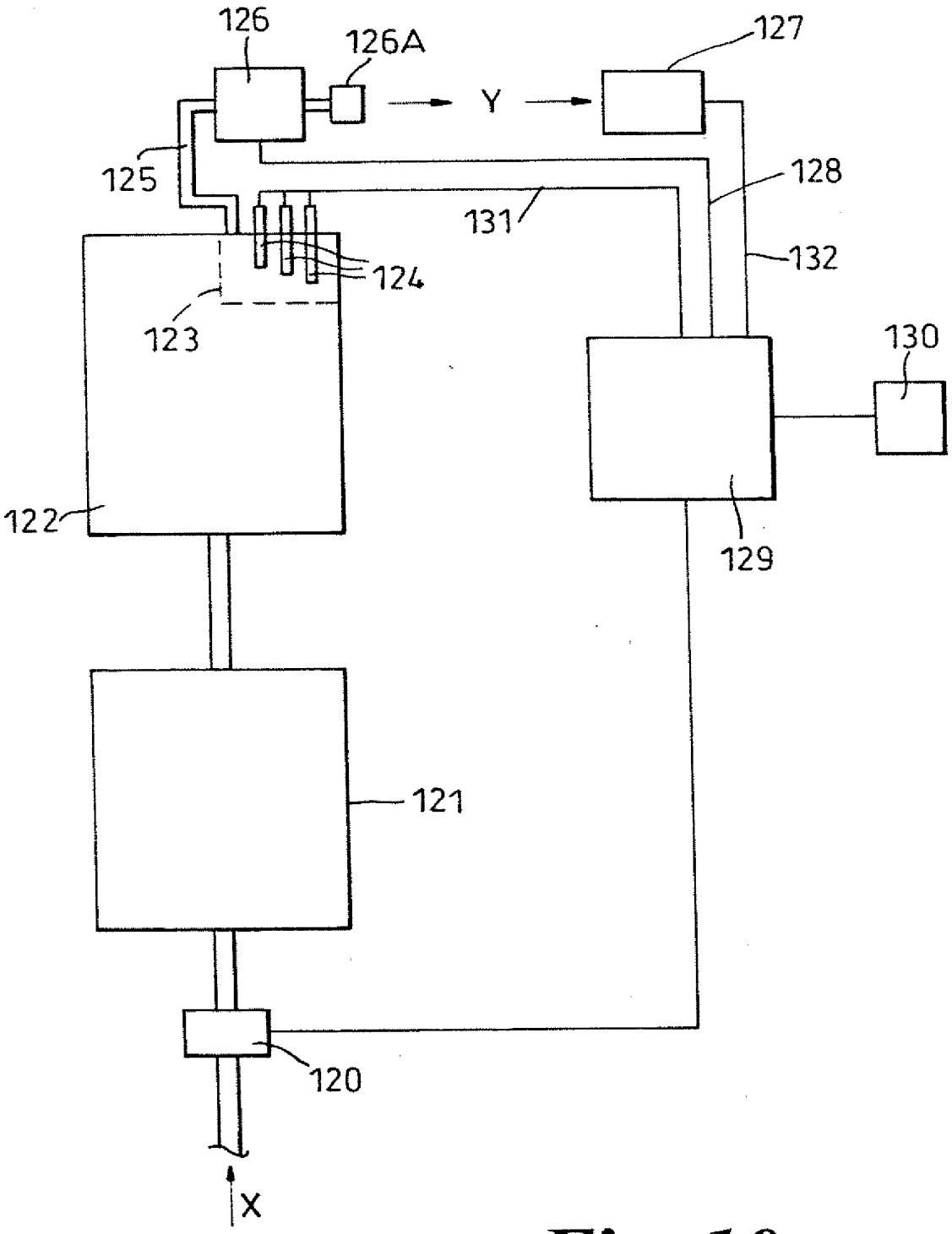

Fig. 10

WATER TREATMENT DEVICE WITH LIQUID LEVEL CONTROL

This invention relates to water treatment and is particularly concerned to provide a means of purifying water in an apparatus suitable for use in a post-mix beverage dispenser, although it will be appreciated that water treated according to the invention may be used for other purposes.

Water quality and purity vary considerably from location to location and it is an object of the invention to provide a means whereby the water to be used in a post-mix dispenser or for other use can be rendered of the desired quality and purity using a relatively simple to operate and renewable means.

To be suitable for use in beverages water should not have excessive bicarbonate, carbonate and organic matter. Chlorine and heavy metals may also need to be removed.

It is, therefore, another object of the present invention to provide a means whereby such undesirable impurities in the water can be removed.

Accordingly the invention provides in one aspect a water treatment apparatus comprising a housing having an inlet for the water to be treated and an outlet for the treated water, treatment means within the housing to remove impurities from the water and one or more probes within the housing to detect the level of water in the housing, wherein the probes are fitted within a separate chamber in the housing, the chamber receiving only treated water from the treatment means within the housing.

Conveniently the water level probes, which may be of the conventional type known in the art, are fitted into a pocket forming part of the lid of the housing, i.e. the probe chamber is part of the lid. Water to be treated is passed into the lower part of the housing below the chamber where it is treated by known means and is then passed into the probe chamber and from there to the outlet for treated water.

By this means the probes are only ever in contact with treated water so that they are not rendered inoperative by gradual calcification. Moreover, the probes chamber provides a "quiet zone" free from turbulence. This latter point is particularly important as it enables a more accurate response to be obtained from the probes and greatly reduces the risk of spurious signals.

There may be, for example, three water level probes in the chamber, one to indicate that a maximum water level has been reached, one to indicate that the water level is low, i.e. at minimum normal operating level, and a third to indicate that the chamber is out of water. Appropriate controls can be activated by the probes to start, stop or continue the water treatment process.

The probes chamber may also be provided with a filter to ensure no unwarranted entry of particulates into the chamber.

In a particularly preferred embodiment a barrier is provided between adjacent probes to prevent shorting between the probes that might otherwise be caused by droplets of water on the underside of the roof of the chamber forming a continuous path between the probes. The barrier may take the form, for example, of one or more projections, extending downwardly from the chamber roof, each projection extending between a pair of adjacent probes.

The housing preferably contains or consists of a disposable canister or cartridge in which the water is treated and the probe(s) may be in a chamber depending from a lid for the canister.

The canister may contain various means for the treatment of the water.

Thus for example, the canister may contain from its base upwards several layers of filtration medium and/or ion exchange resin to remove various impurities as is well known in the art. Thus layers of metal filters and/or carbon may be used to remove bicarbonates and other solid impurities and an activated carbon screen to remove organics, chlorine and the like.

It may also contain a heater which may, for example, extend upwardly from the centre of the base of the canister to heat the water being treated.

The treated water may pass from the canister to one or more heat exchangers where it is cooled before being passed for use or storage, e.g. in a bag-in-box type storage reservoir. It may be cooled in the heat exchanger by incoming untreated water passing through the heat exchanger before entering the housing, e.g. the canister.

It will be appreciated that the canister gradually fills with impurities removed from the water, e.g. deposited carbonates, and in due course will lose its efficiency to the point where a replacement canister is needed and the used canister is thrown away. In another aspect, therefore, the invention provides improved detection means to indicate when such replacement is needed.

In one embodiment the through put in litres of treated water from the outlet of a housing containing water treatment means is measured.

Thus the outlet for a water treatment housing comprising a disposable canister containing water treatment means is provided with volumetric measuring means for treated water passing through the outlet. The volumetric measuring means may be connected to visual and/or audible warning means to indicate that a pre-determined level of throughput has been achieved so that the canister should be replaced.

In a further aspect, where detection means to indicate housing, e.g. canister, replacement are used with the water level probes, the invention provides electronic timing control between the probes to measure the rate of filling of the housing. Thus, for example, where a pair of probes indicate the maximum and minimum normal operating levels for the water, the time taken to fill from the lower to the upper level is measured and fed to a programmed control means. The control means monitors the filling times t_2 in comparison with filling time t_1 for a new canister. t_2 can be averaged over a large number of fillings so that any trend in the ratio of t_2 to t_1 is monitored. When the ratio reaches a predetermined value, the controls operate an indication that replacement of the canister is now needed.

The number of fills taken to calculate the average fill time may vary with the size of the canister. For example, the average may be monitored over a 1000 fill series for a canister requiring five minutes to fill. A continuous, rolling series of 1000 or 100 fills can, therefore be monitored to indicate the trend of filling times.

As indicated above, the water treatment apparatus of the invention may comprise heating means to heat the water being treated. In a further embodiment the heating means comprises a heater attached to the base of the housing.

The heating means may in a preferred embodiment be printed onto the flat base of the housing by means known *per se* in the art.

In another embodiment the invention provides an improved heat exchanger arrangement for use with the water treatment apparatus.

In one conventional arrangement the heat exchanger is a tube in tube construction wherein water to be treated passes through one tube and is heated before passing to the inlet of the water treatment housing by the treated water which passes from the outlet through the other tube and is thereby cooled by the water to be treated. However, calcium deposits build up in the heat exchanger at about 60°C and rapidly reduce its efficiency.

Accordingly the invention provides an improved heat exchanger for use with the water treatment apparatus, the heat exchanger comprising a disposable canister containing the heat exchanger element.

Thus the invention also provides a water treatment apparatus comprising a housing having an inlet for water to be treated and an outlet for treated water, treatment means within the housing to remove impurities from the water, the treatment means including means to heat the water, and a heat exchanger connected to the housing to cool the treated water flowing from the outlet, the heat exchanger comprising a disposable canister containing the heat exchanger elements.

The heat exchanger may be a two stage heat exchanger in which the first stage is a disposable canister and the second stage is a conventional heat exchanger. By this means, pre-heating of the water to be treated in the disposable canister provides a preliminary removal of deposits, e.g. from carbonate impurities, and this canister can be replaced at regular intervals, e.g. 6 months, whereas as the second stage

heat exchanger which may be the main boiler will then have a prolonged life.

However, if desired, a two stage heat exchanger system may be utilised in which both stages comprise disposable elements.

The disposable heat exchanger may be, for example, a "coil in a can" or "tube in a can" or a "tube in tube" type.

In each arrangement the outgoing treated water heats the ingoing water to be treated and the ingoing water cools the outgoing water. For example, ingoing water may be supplied to the heat exchanger at about 10°C and fed to the housing containing the water treatment means at about 90°C, where it may be further heated so that it leaves as treated water at about 115°C.

Cooled treated water from the heat exchanger may conveniently be stored, for example, at ambient temperature.

Thus in one embodiment both the heat exchanger and the water treatment housing are provided as disposable canisters. They may conveniently be provided in a single container or case.

In order to ensure that the outlet line from the heat exchanger(s) to a reservoir for the treated water is kept free of build up of contamination, e.g. microbiological contamination, the outlet for hot treated water from the treatment canister may be divertable to miss out the heat exchanger so that it passes directly along the line to the reservoir. Thus the line may be sterilised from time to time, e.g. at start up or when a bag-in-box type reservoir is being changed. During this cleansing operation, the cold ingoing water may be passed directly to the treatment canister.

The disposable water treatment canister may be housed in a rotatable cradle within an outer container or case. The disposable canister is held in its desired operating position under any required pressure by the cradle and both the cradle and the canister are pivotally attached to a frame whereby they may be rotated to be accessible for change of the canister. The frame may be constituted by or comprise piping above the canister for the water flows or may be quite separate. The cradle and the canister may be pivoted on different pivot lengths, i.e. are eccentric with respect to the other, so that they separate when they are rotated to the change or release position, whereby the canister may be readily removed. A simple release cam action may be provided to effect this.

It will be appreciated that the housing containing the water treatment means may be equipped with other conventionally used means, e.g. temperature sensors and gas, including steam, escape valves. Escaping steam may be passed through a heat exchanger and collected as a condensate for disposal.

Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings in which:-

Figure 1 is a diagrammatic part sectional view of one embodiment of the invention;

Figure 2 is a scrap view of a portion of the arrangement of Figure 1 taken along line II-II of Figure 1;

Figure 3 is a perspective view with parts cut away of one means of mounting the water level probes used in the invention;

Figure 4 is a sectional view of an alternative means of mounting the probes;

Figure 5 is a perspective view of a disposable cartridge, mounted in a rotatable cradle, and a heat exchanger within an outer container;

Figure 6 is a similar view to Figure 5 in part section;

Figure 7 is a sectional view of the disposable cartridge of Figures 5 and 6;

Figure 8 is an exploded view of a portion of the mounting means for the cartridge;

Figure 9 is a scrap view of another portion of the mounting means; and

Figure 10 is a schematic arrangement of another embodiment of the invention.

In Figures 1 and 2 the apparatus comprises a housing 10 having a base 11 and a lid 12. A recess 13 extends upwardly from base 11 to approximately half of the height of the housing 10 and contains a heater 14. An inlet 15 allows untreated water into housing 10 through its base 11 as indicated by arrow A. A series of baffles 16 extends across the lower half of housing 10 from base 11 almost to the height of the heater 14 in recess 13. The baffles extend alternately from one side of the housing almost to the other side to leave gaps 17 for passage of the water upwardly in sinusoidal fashion as indicated by arrows B.

Above the upper extent of recess 13 a filter layer 18, e.g. of sand or other filtration medium, is contained between a pair of mesh screens 18A and extends across the interior of the housing to filter solid material from the heated water passing upwardly through it.

A chamber or compartment 19 is formed, inside the upper right hand region of housing 10 as shown, by an arcuate wall 20 and a portion 10A of the housing wall. An outlet tube 21 is provided for treated water

to pass out through lid 12 of housing 10 in the direction of arrow C. Outlet tube 21 has its inner end inside housing 10 located towards the lower end of compartment 19. The water level inside the housing is indicated at 22.

An outlet valve 23 in lid 12 allows escape of steam, hot water and unwanted volatiles given off from the water and is designed to operate at a predetermined pressure, e.g. 0.7 bar.

Inside compartment 19 are three water level probes 24, 25, 26 connected by means not shown to conventional monitoring means. Probe 24 indicates the maximum desired water operating level and probe 25 the normal minimum operating level. Probe 26 indicates that the compartment is virtually out of water and that the heater should be switched off until the water level has risen again.

A filter 28 (optional) across the base of compartment 19 prevents entry of any particulate material into the compartment.

Pressure of incoming untreated water through inlet 15 forces the water upwardly through the housing 10 to above the level of filter 18. Steam pressure generated by heating forces treated, heated water out through outlet 21, where it may be passed, optionally after cooling in a heat exchanger, to a reservoir.

In Figure 3 is shown a cylindrical mounting block 30, e.g. of solid plastics material, for three water level probes 32, 34 and 36, which pass longitudinally through holes formed through the block. The block can be fitted into a correspondingly-sized hole in the lid of a water treatment housing (such as lid 12 of housing 10 in Figure 1) so that the probes protrude into a probe compartment in the housing. At the lower end (in use) of the block 30 three arcuate walls 38, 40 and 42 have been formed

by cutting away three equi-spaced segmental portions from the end of the block, thereby leaving a central barrier in the form of three arms 44, 46, 48, each arm separating an adjacent pair of probes. By this means, any water droplets forming on the lower surface of the mounting block cannot form a continuous path between adjacent probes and hence shorting between the probes is prevented.

An alternative barrier means to prevent shorting between probes is shown in Figure 4. Here a pair of probes 50, 52 pass through a mounting block 54 to enter a probe compartment in a treatment housing (not shown). The undersurface 56 of the mounting block is provided with annular extensions or collars 58, 60 through which the probes pass. Water droplets 62 which form on undersurface 56 are prevented by collars 58, 60 from providing a continuous path between the probes 50, 52.

In Figures 5 and 6, a heat exchanger 71 and a water treatment housing, comprising a cartridge 70 mounted inside a cradle 70A, are mounted side-by-side in a container 72, the front lid of which has been removed. Water to be treated passes through a solenoid valve-controlled inlet 73 via a pipe 74 and a pressure regulator 75 into the heat exchanger 71 where it passes downwardly outside the coils 76 of the heat exchanger to its base and then upwardly in the cylindrical space defined by the inner faces of coils 76. It exits through the top of the heat exchanger into pipe 77.

Pipe 77 rises vertically and then turns horizontally to enter cartridge 70 near the top of its sidewall. (This horizontal portion of travel of pipe 77 is hidden in the drawings behind pipe 74.). Pipe 77 passes into the head 78 which closes the upper end of the cartridge 70.

Inside head 78 pipe 77 meets a wider pipe 80 which extends downwardly through upper space 81 inside the cartridge and then through several layers of baffles and/or filtration medium 82 almost to the bottom of the cartridge.

Inside the cartridge there is also a heater (not shown).

The incoming water exiting from the bottom (not visible) of pipe 80 is heated as it is forced upwardly through the layers 82. Attached to the underside of head 78 is an arcuate extension 82A which extends downwardly almost to the uppermost layer of filtration medium. Extension 82A in conjunction with a portion of the interior wall of the cartridge defines a compartment or "quiet zone" 83 containing water level probes. The probes are not visible in Figure 6 but see the description below with reference to Figure 7. An outlet for treated water in compartment 83 leads into a pipe 85 which passes through head 78 and then exits at the left hand side of cartridge 70 and then turns back on itself to reach the heat exchanger 71 where it passes the heated treated water into the upper end of coils 76.

From the lower end of coils 76, the now cooled treated water passes up pipe 86 to exit through the top of the heat exchanger into pipe 87. Pipe 87 leads to a solenoid valve-controlled outlet 88 from where the cooled treated water can be passed to a reservoir.

A relief valve 93 mounted on head 78 and connected to the inside of the cartridge allows steam/water/volatiles above a set pressure to exit through pipe 89 and coil 90 to a drain outlet 91.

When the container 72 is open, the cradle arrangement allows the used cartridge to be swung outwardly for renewal and replacement. This is shown in more detail in Figures 7, 8 and 9.

In Figure 7 can be seen water level probes 94, 95, 96 inside compartment 83 defined by extension 82A. An outlet pipe 85A allows treated water to pass via a labyrinth 85B into the outlet pipe 85 from the canister. Also an O-ring seal 97 can be seen, which seals the head 78 to the inside wall of the cartridge 70.

The probes 94, 95, 96 are connected via a control box (not shown) to indicator lights 92 which are used to indicate the status of the treatment process, e.g. normal operation, and low water level as indicated above.

The cradle 70A is pivotally mounted on a bracket 100, which can be fixed to the wall of casing 72 or to a suitable frame inside the casing. Bracket 100 has a central portion 101 of length a little more than the diameter of the cartridge and an outwardly depending arm 102, 103 at each end. Each arm 102, 103 contains a hole 104, 105 respectively and a boss 106, 107 is fitted into each hole whereby it cannot move therein. Bosses 106, 107 are attached to the cartridge opposed across its diameter.

Cradle 70A has a base 70B and an arm 70C, 70D extending upwardly from each extremity of the base. (The base of cartridge 70 sits on the base 70B of the cradle). Adjacent the upper end of each arm 70C, 70D is a hole 70E, 70F by means of which the arms of the cradle may be pivotally attached to their respective bosses 106, 107.

Each boss 106, 107 is drilled to contain an off-centre through hole 108 (Figure 9) through which inlet pipe 77 and outlet pipe 85 are attached to the cartridge 70. Cartridge 70 is thereby pivotally suspended to bracket 100 on a different centre of rotation to that of cradle 70A.

Thus, when it is desired to replace cartridge 70, the cartridge and the cradle 70A can be swung outwardly and their respective axes of rotation can be fixed such that the cartridge moves clear of the cradle and can be removed and replaced.

In Figure 10 untreated water, e.g. from the mains, enters the apparatus in the direction of arrow X via an on-off valve 120 and into heat exchanger 121. From heat exchanger 121 the water passes into treatment cartridge 122 where it is heated and filtered in a similar manner to that described above. A compartment 123 at the upper end of cartridge 122 contains three level probes 124, again for use as described above. From the compartment the heated treated water passes through outlet pipe 125 via a solenoid controlled valve 126 and an optional volumetric flow meter 126A and from there to a reservoir 127 in the direction of arrow Y. The flow meter is connected via line 128 to an electronic control board 129 whereby warning indicator 130 can be activated when a predetermined volume of treated water has passed through flow meter 126A. Treatment cartridge 122 is then due for replacement.

Alternatively, instead of using the volumetric flow meter, the probes 124 maybe used as described above to feed information via line 131 to control board 129 whereby the time t_2 to fill the cartridge between the minimum and maximum operating levels is monitored relative to the corresponding time t_1 when the cartridge is new. When the ratio t_2 to t_1 falls to a predetermined level, the control board actuates warning indicator 130.

The reservoir 127 is also connected to control board 129 via line 132 whereby the valve 120 may be closed when the reservoir is full.

It will be appreciated that outlet pipe 125 from the treatment cartridge 122 may pass the treated water back through the heat exchanger, either before or after the flow meter, and from there into reservoir, if it is desired to use the heat exchanger to cool the treated water.

CLAIMS

1. A water treatment apparatus comprising a housing (10, 70) having in inlet (15; 77, 80) for the water to be treated, an outlet (21, 85) for the treated water and treatment means (14, 16, 17, 18, 18A, 82) within the housing (10, 70) to remove impurities from the water, characterised in that one or more probes (24, 25, 26, 32, 34, 36) are provided within the housing to detect the level (22) of water in the housing, the probes (24, 25, 26, 32, 34, 36) being fitted within a separate chamber (19) in the housing, the chamber (19) receiving only treated water from the treatment means within the housing.

2. A water treatment apparatus according to Claim 1, characterised in that the probes (24, 25, 26) are fitted into a pocket (19) forming part of the lid (12) of the housing (10).

3. A water treatment apparatus according to Claim 1 or 2, characterised in that there are three water level probes (24, 25, 26) in the chamber (19), one (24) to indicate that a maximum water level has been reached, one (25) to indicate that a minimum operating level has been reached and a third (26) to indicate that the chamber (19) is out of water.

4. A water treatment apparatus according to Claim 1, 2 or 3, characterised in that the probes (24, 25, 26, 32, 34, 36, 124) actuate controls to start, stop or continue the water treatment process.

5. A water treatment apparatus according to any preceding claim, characterised in that a filter (28) is provided to prevent entry of particulates into the chamber (19).

6. A water treatment apparatus according to any preceding claim, characterised in that a barrier (44, 46, 48; 58, 60) is provided between

adjacent probes (32, 34, 36; 50, 52) to prevent shorting between the probes.

7. A water treatment apparatus according to Claim 6, characterised in that the barrier (44, 46, 48; 58, 60) is in the form of one or more projections extending downwardly from the chamber roof (12), each projection extending between a pair of adjacent probes.

8. A water treatment apparatus according to any preceding claim, characterised in that the treatment means comprises several layers (82) of filtration medium and/or ion exchange resin.

9. A water treatment apparatus according to any preceding claim, characterised in that the treated water passes from the outlet (85) to a heat exchanger (71) where it is cooled before being passed to storage.

10. A water treatment apparatus according to Claim 9, characterised in that the treated water is cooled in the heat exchanger (71) by incoming untreated water passing through the heat exchanger to the inlet (77, 80) of the housing (70).

11. A water treatment apparatus according to any preceding claim, characterised in that the housing comprises a disposable cartridge (70).

12. A water treatment apparatus according to any preceding claim, characterised in that it includes a volumetric measuring means (126) for the treated water passing through the outlet (125).

13. A water treatment apparatus according to Claim 11 or 12, characterised in that an electronic timing control means (129) is provided between a pair of probes (124) which indicate the maximum and minimum normal operating water levels respectively, to measure the rate of filling of the cartridge (122).

14. A water treatment apparatus according to Claim 13, characterised in that the control means (129) is programmed to monitor the filling times (t_2) in comparison with the filling time (t_1) for a new cartridge.

15. A water treatment apparatus according to Claim 14, characterised in that the control means (129) is programmed to monitor the ratio of t_2 to t_1 over a predetermined number of fillings and operates an indicator to warn that cartridge replacement is needed when the ratio reaches a predetermined value.

16. A water treatment apparatus according to Claim 15, characterised in that the control means (129) is programmed to monitor the ratio of t_2 to t_1 over a continuous rolling series of from 100 to 1000 or more fills of the cartridge.

17. A water treatment apparatus according to any preceding claim, characterised in that the treatment means includes a heater (14).

18. A water treatment apparatus according to Claim 17, characterised in that the heater (14) is attached to the base (11) of the housing (10).

19. A water treatment apparatus according to Claim 18, characterised in that the heater is printed onto a flat base of the housing.

20. A water treatment apparatus according to any one of Claims 9 to 19, characterised in that the heat exchanger (71) comprises a disposable canister containing the heat exchanger elements (76).

21. A water treatment apparatus according to Claim 20, characterised in that the heat exchanger is a two-stage heat exchanger in which the first stage is a disposable canister and the second stage is a conventional heat exchanger.

22. A water treatment apparatus according to any one of Claims 9 to 21, characterised in that the outlet from the water treatment housing has

a by pass valve to miss out the heat exchanger whereby the hot treated water can pass directly along a line to a reservoir, whereby that line may be sterilised.

23. A water treatment apparatus according to any one of Claims 11 to 22, characterised in that the disposable cartridge (70) is housed in a rotatable cradle (70A, 70B), the cradle and cartridge being pivotally attached whereby they may be rotated to be accessible for change of the cartridge.

24. A water treatment apparatus according to Claim 23, characterised in that the cradle (70A, 70B) and cartridge (70) are pivoted at different pivot lengths so that they separate when rotated to the change position.

25. A water treatment apparatus comprising a housing (10, 70) having an inlet (15, 77, 80) for the water to be treated, an outlet (21, 85) for the treated water and treatment means (14, 16, 17, 18, 18A, 82) within the housing (10, 70) to remove impurities from the water, characterised in that at least two probes (24, 25,) are provided within the housing to detect the level of water in the housing, a first probe (24) being positioned to indicate the maximum normal water operating level and a second probe (25) to indicate the minimum normal water operating level, the probes being connected to electronic control means (129) to measure the rate of filling of the housing from the second to the first probe.

26. A water treatment apparatus according to Claim 25, characterised in that the control means (129) is programmed to monitor the filling times (t_2) in comparison with the filling time (t_1) for a new housing.

27. A water treatment apparatus according to Claim 26, characterised in that the control means (129) is programmed to monitor the ratio t_2 to

t_1 over a predetermined number of fillings of the housing from the second to the first probe and operates an indicator (130) to warn that housing replacement is needed when the ratio reaches a predetermined value.

28. A water treatment apparatus according to Claim 27, characterised in that the control means (129) is programmed to monitor the ratio of t_2 to t_1 over a continuous rolling series of filling of the housing from the second to the first probe.

29. A water treatment apparatus according to any one of Claims 25 to 28, characterised in that the probes (24, 25, 26) are fitted within a separate chamber (19) in the housing, the chamber only receiving treated water from the treatment means.